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Country review of raw material resources for the fertilizer industry in Africa

LC/NAIR08

Review of raw material resources for the fertilizer industry in Africa

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ALGERIA

Algeria is favourably endowed with natural resources of importance to the fertilizer industry. The country has considerable resources of petroleum, natural gas, phosphate rock, some coal, iron pyrites and potash.

The country has imports of substantial amounts of fertilizer materials but it became an exporter of ammonia for the first time in 1981. The country imports all its potash requirements mostly in the form of potassium sulphate from Spain, substantial amounts of triple superphosphate largely from the United States (Table 8). Completions of fertilizer plants, and expansion plans to a phosphate mine should reduce phosphate fertilizer imports considerably.

Phosphate

Algeria has large phosphate rock deposits centred around Djebel Onk near the Tunisia border. The major deposit and mine at Djebel Onk has reserves estimated at over 200 million tons. Nearby at Kouif there is an older deposit whose reserves are now near depletion.

The country has phosphate reserves of over 3 billion tons averaging over 25 per cent P_2O_5 and over 500 million tons averaging 9 to 21 per cent P_2O_5.

Phosphate rock production was about 1.0 million in 1981 and 1.25 million in 1982. The Djebel Onk mine is undergoing expansion to raise its output to 2 million tons per year by 1986.

At the same time phosphate processing facilities have been expanded to minimize exporting low-valued raw materials.

A new fertilizer complex at Annaba has annual rated capacities of about 230,000 tons of diamonium phosphate, 200,000 tons of monoammonium phosphate, 165,000 tons of phosphoric acid and 530,000 tons of sulphuric acid.

At Tebessa two new phosphate units with annual capacities of 165,000 tons of phosphoric acid and 280,000 tons of triple super phosphate and 530,000 tons of sulphuric acid have been developed.

Older facilities include the plants: at El Harrach (Algiers) constructed in 1902 with annual capacities of 20,000 tons of sulphuric acid and 30,000 tons of single super phosphate; at Annabe constructed in 1948 with annual capacities of 20,000 tons of sulphuric acid and 40,000 tons of single superphosphate; and at La Senia (Oran) constructed in 1959 with annual capacities of 40,000 tons of sulphuric acid and 60,000 tons of single superphosphate. Production of single superphosphate from the three plants is reported to be about 65 per cent of rated capacity (Directory of Fertilizer Production Facilities PP.52).

In addition to the above facilities there are over seventeen fertilizer blending plants in the country and a number of compounding plants.

Nitrogenous fertilizers

Sonatrach, a government agency has set up a fertilizer comples at Arzew. The plants at Arzew have rated annual capacities of 350,000 tons of ammonia (from natural gas), 150,000 tons of nitric acid, 175,000 tons of ammonia nitrate and 150,000 tons of urea. However the plants' output has been considerably below the rated capacities.

Another new amonia unit of the same capacity as that of Arzew has been constructed within the Annaba fertilizer complex. A 350,000 ton-per-year ammonium phosphate plant and a 260,000 ton-per-year nitric acid plant have also been planned for development at Annaba.

A fourth ammonia unit with the same capacity as the Annaba complex is to be set up at Skikda and is projected to start in 1987 (Mineral Yearbook 1981, PP.54).

Coal

Coal is found in several locations in the country. Total reserves are estimated at more than 20 million tons.

Iron pyrite

Substantial reserves of iron pyrites are found on the coast near Annaba. The pyrites have an average content of 45 per cent sulphur. The equivalent of about 15,000 tons of sulphur has been produced annually and used mainly in the manufacture of sulphuric acid.

ANGOLA

Angola has oil and gas reserves as well as coal and a hydroelectric power potential (Table 1).

Phosphate rock deposits are found in the Cabindoc area where reserves of about 40 million tons have been estimated.

An open cast mine was opened at Quindonacache in 1981 with an annual capacity of 15,000 tons of phosphate rock averaging over 30 per cent P_2O_5.

In the Lower Zaire Basin on the Lueunga River valley, about 100 km. south of the Zaire River, three deposits of phosphate containing some 30 million tons of rock were discovered.

Sulphur deposits have been discovered in the Benguela Basin in the south-west coast.

Fertilizer manufacture: Angola has no fertilizer production inspite of the existing potential. The country has a production capacity of 380,000 tons of sulphuric acid.

BENIN

Benin has petroleum resources discovered in 1968, but has no gas production nor does it have coal reserves.

Phosphate rock deposits which are extensions of the Togo deposits are found at Pohe near the Togo border. About 4.5 million tons of phosphate resources have also been located at Mekrou in the North. This deposit has its equivalent in the Niger and Burkina-Faso. These deposits belong to the sedimentary phosphate beds of the Oti Series which also extend into Ghana.

No exploitation of phosphate rock has been done and there is no production of nitrogenous fertilizers. The country's fertilizer consumption is low; Fertilizer imports in 1981/82 were only 2,800 tons, mainly potash.

BOTSWANA

The country does not have any known phosphate or potash reserves or oil and gas. It however has some of the largest and most viable coal deposits in Africa.

Fertilizer consumption is low. Only a total of 1,400 tons of NPK fertilizers was consumed in 1981/1982.

There are no plans for a fertilizer industry in the country.

BURKINA FASO

Two commercial deposits of sedimentary phosphate rock were discovered some years back in the Oti Series of Lower Paleozoic or Precambrian age. The same formation is known to contain mineable phosphate deposits in two nearby areas in the Niger and equally in Benin, whereas the Oti beds are also encountered in the Voltaian formation in Ghana but have not yet been thoroughly investigated in that country.

The Arly and Kodjani-Tausarga deposits have estimated reserves of the order of 35 million tons and are currently under development while experiments are simultaneously under way to set up a low-cost fertilizer industry ba ed on these phosphate rock resources.

BURUNDI

Burundi has peat and phosphate resources. It also shares with Rwanda and Tanzania the undeveloped hydroelectric power potential of the Kagera river whose exploitation is under consideration at Rusumo on the Tanzanian border in the context of the Kagera water basin scheme.

Investigations have been in progress to assess the vast peat resources in the country estimated at 3 billion m^3 and to prove their viability for both energy and agricultural uses.

A phosphate deposit consisting of afatize in a carbonalite has been discovered around Matongo - Bandaga. A feasibility study to evaluate the reserves and to establish mining and processing requirements as well as marketing aspects has been commissioned by the Government in 1981/82.

Establishment of a fertilizer industry would alleviate some of the expensive inland transportation of agricultural inputs and some of the production could be exported to Rwanda and eastern Zaire.

CAMEROON

Cameroon has petroleum and gas reserves (Table 7) but has no phosphate or potash resources.

The total NPK fertilizer consumption in 1981/82 was about 42,000 tons.

Based on its gas resources the country has been able to manufacture some nitrogen fertilizers.

CENTRAL AFRICAN REPUBLIC

The country has neither proven oil gas nor phosphate and potash resources. However, calcium - uranium phosphate and copper-uranium phosphate mineralizations are reported in the Eocene of the MPatou cuvette at Bakouma, 480 km. east, north-east of Bangui. Its consumption of fertilizers is also low, having totalled only 1,200 tons of NPK in 1981/1982.

Conditions for the development of fertilizers in the country are at the moment not favourable.

CHAD

No fertilizer raw materials have been discovered in Chad. The country has programmes to evaluate its hydrocarbon, hydroelectric (Gauthiot Falls) and geothermal potential.

CONGO

Congo is one of the few countries in Africa together with Ethiopia, Morocco, Libya, Tunisia and South Africa with potash reserves and the only one to have developed a large potash mine which was flooded in 1977.

The country also has petroleum, gas and some non-commercial off-shore phosphate resources which were discovered in the context of a United Nations Revolving Fund exploration programme (Table 1). In addition, some minor occurrences of phosphate rock in the coastal sedimentary basin of Congo have been discovered at Tehivila, Sintou-Kola, Loufika and Kintanzi.

Potash

Large potash deposits were discovered in the coastal sedimentary basin of the Congo extending 100 km. in length and 48 km. in width and a mine was developed at Holle in the late 1960s to exploit these deposits.

The deposits consist of sylvinite and carnallite. In the mine concession area sylvinite is found in a 3.2 m. thick bed about 380 m below surface over an area of 10 km^2. At the start of the mine, reserves of sylvinite were estimated at about 20 million tons of K_2O equivalent with additional possible tonnages of 4 million tons of K_2O equivalent.

Carnallite deposits in the same mine concession extend over an area of 27 km^2. They are found in two layers having an average thickness of 1.8 metres. Reserves at the start of the mine were estimated at 4.6 million tons of K_2O with possible additional tonnages of 13.5 million tons of K_2O equivalent.

The deposits are nearly flat and are capped by a water-tight anhydrite gypsum bed about 300 metres below the surface. Water-bearing formations are found above the anhydrite-gypsum bed formation and care had to be exercised in mine development and mining to avoid disruption of this formation.

Mining and processing

Mining was designed to produce 830,000 tons per year of marketable potassium chloride equivalent to 500,000 tons of potash.

A room and pillar underground method was adopted with an extraction rate of 45 per cent of the ore. Mining was by continuous miners and haulage was by shuttle car and a conveyor belt system to an underground primary crushing and automatic skip loading installation.

Ore from underground was further milled to minus 1/8" material. The ore was then agitated in saturated brine to loosen any clay associated with the ore. The material was then screened to separate coarse and fine ore and the two fractions were separately subjected to flotation to recover potassium chloride. The products were then filtered and dried.

Transportation of the products were by rail to a sea terminal which had been built at Pointe Noire.

Markets for the products were in Europe, South America, other African countries and India.

The potash mine was operated by Compagnie des Potasses du Congo from 1971 to 1977, after which it was flooded by an aquifer and was closed.

During its operation production was as follows:

1972/1973	283,000 tons
1973/1974	263,000 "
1974/1975	263,000 "
1975/1976	266,000 "

The government is looking into possibilities of reopening the mine. Consideration has been given to solution mining of the carnallite ore.

Phosphate

At Pointe Indienne there are reserves of phosphate rock of about 5 million tons with 52 per cent BPL but these have not been exploited.

Fertilizer manufacture

There is no fertilizer manufacture in the Congo, although the country has gas and potash resources. Fertilizer consumption in the country is small and this is not likely to encourage the early establishment of the industry.

DJIBOUTI

Djibouti has no known fertilizer raw materials and has negligible fertilizer consumption.

EGYPT

Egypt has been one of the most important and steadily growing producers of fertilizers in Africa (Table 8).

The country has large reserves of phosphate rock, considerable reserves of petroleum and natural gas, some sulphur, coal and large hydroelectric power potential (Table 1).

The completion of the Aswan High Dam eliminated annual floods which provided natural fertilization for the River Nile basin soils and has increased the country's dependence on chemical fertilizers. In 1981/82 about 585,000 tons of nitrogen in ammonia and urea and 110,000 tons of P_2O_5 in phosphatic fertilizers were used when compared to respective consumption figures of 331,000 tons of N and 40,000 tons of P_2O_5 in 1971/72. Between 1975 and 1981 the country imported an average of about 250,000 tons per year of nitrogenous fertilizers equivalent to about half the annual consumption. A number of projects have recently been implemented or are under implementation which should make Egypt self-sufficient in chemical fertilizers by about 1985.

Phosphate rock and Phosphatic fertilizers

Egypt produced about 700,000 tons of phosphate rock in 1982 with an estimated P_2O_5 content of 20 per cent. Phosphates in the country have been exploited in two main areas:

(a) The Red Sea district near Kassier and Safage;

(b) The Nile Valley area at Sibaiya near Luxor. More recently production has come from Hamrawein in the east. Large reserves have also been discovered at Abu Tartur in the Western Desert and in the Red Sea district the phosphate deposit is found about 500 metres below the surface. After mining, the material is washed and calcined to obtain about 64 per cent tricalcium phosphate which is mainly exported as the mine is only about 25 km from the ports.

Production at the Kassier and Safage mines has been on the decrease and in 1982 was about 180,000 tons and the mines might be depleted by 1985.

Production from the Hamrawein deposit in the Eastern Desert has been increased and a mine and plant with an annual capacity of 600,000 tons of phosphate concentrate averaging 33 per cent P_2O_5 has been constructed. Another mine has been planned at Abu Sheigela close to Hamrawein which would replace the Kossier and Safage mines when they are depleted.

A new phosphate deposit whose tonnages have not been specified has also been discovered near Wadi Quna in the Eastern Desert.

In the Nile Valley deposits the phosphate is near surface and is mined by open pit. Output from the West Sabaya mine is being increased from 120,000 tons to 500,000 tons a year of phosphate concentrate to be used on a triple superphosphate and phosphoric acid fertilizer plant at Abu Zaabal.

The deposit at Abu Tartur is Egypt's largest phosphate deposit with reserves of over 1 billion tons containing 25 per cent P_2O_5. About 100,000 tons of phosphate concentrate was produced from a pilot plant in 1981. Government has planned to increase annual output to 6 million tons by 1986.

Phosphatic fertilizers

The Abu Zaabal fertilizer complex 20 Km. north of Cairo has been expanded to produce triple superphosphate and phosphoric acid in addition to single superphosphate (Table 8). The complex also produces sulphuric acid. Building of another unit to produce 215,000 tons per year of sulphuric acid and 100,000 tons of 65 per cent oleum began in 1980.

There have also been plans to build a combined nitrate-phosphate fertilizer complex in the Red Sea area to utilize the phosphate rock from the Abu Tartur deposit and gas from the Gulf of Suez gasfields. The complex would produce 1,000 tons of ammonia and 1,700 tons of urea per day and 300,000 tons per year of diammonium phosphate.

Nitrogenous fertilizers

Table shows nitrogen fertilizer plants. Feedstock for the Talkha I and Talkha II Plants is gas from the Abu Madi gasfield in the Nile Delta while feedstock for the Abu Qir ammonia-urea plant is from the Abu Qir gasfield. There have been plans to expand the Abu Qir plant by the Addition of a 150,000 tons-per-year ammonium nitrate plant to absorb excess ammonia and a 135,000 tons-per-year nitric acid plant.

Sulphur and Sulphuric acid

Egypt produces elemental sulphur as a by-product of the petroleum industry. The sulphur is used in the manufacture of sulphuric acid for the fertilizer industry. Production of sulphur and sulphuric acid between 1977 and 1981 was as follows:

	1977	1978	1979	1980	1981
Elemental sulphur (tons)	5,000	3,106	3,206	3,300	2,408
Sulphuric acid (tons)	NA	NA	3,200	32,000	44,111

EQUATORIAL GUINEA

The country has no known resources for the establishment of a fertilizer industry. There is also little fertilizer consumption in the country (Table).

ETHIOPIA

The country has important potash reserves in the Danakil depression. Potash and sulphur deposits have been found in the Awash Basin. It has no known phosphate resources. Exploration for oil has been in progress and there is development work in geothermal energy.

Several occurrences of sulphur are known in Shoa, Harar, Tigre and Eritrea provinces but they have not been systematically explored.

Potash

Carnallite and sylvite deposits were discovered in the Danakil region in 1906. Deposits in the Dallol area were later exploited by an Italian company up to 1929. About 70,000 tons a year were exported at the peak of the operations.

Efforts to revive the operations have not been successful. An American company R.M. Parsons Company conducted systematic exploration work between 1959 and 1969 and prepared a feasibility report which envisaged a production capacity of 900,000 tons of potassium chloride per year. Lack of financing led to the abandonment of the project.

The Danakil depression in north-eastern Ethiopia is a below-sea-level drainage basin with lowest elevation being about $-_2$120 m. The bottom of the basin is relatively flat and extends over 4,000 km^2 and has a sequence of potash salt horizons of pliocéne or later date.

Three main potash deposit areas have been identified in the depression.

Crescent ore body (near Dallol)

This is a near surface deposit of about 1,000 metres in length and 100 metres in width. It is mainly a carnallite deposit with some sylvinite. R.M. Parsons Comapny reported the ore body to have a potash layer varying from 0 to 60 metres in thickness with an overburden of 0 to 90 metres. Reserves were estimated at 12 million tons with 25 per cent KCl. Recoverable ore had an equivalent of 1.8 million tons of K_2O.

Muslay deposit is found on the western border of the basin, about 4.5 km. west of Dallol. The deposit was investigated by Parsons Company by drilling and underground prospecting over an area of 24 sq km. Reserves in the area investigated were estimated at 157 million tons of sylvinite ore grading 30.7 per cent KCl with the equivalent of 30.4 million tons of K_2O.

There were indications that the potash horizon continues beyond the area investigated by Parsons.

Colluli area

Two potash horizons with similar stratigraphic conditions to the Dallol and Muslay deposits have been discovered at Colluli. An upper potash horizon ranging from 30 to 60 m in thickness is found at depths of 20 to 135 metres. The lower horizon is 350 m below surface.

Investigations carried out by Ethiopian Potash Company covered only 5.5 sq km and there are possibilities of deposits extending beyond this area. Preliminary estimates of reserves, in the area investigated are put at 80 million tons of 20 per cent KCl composed mainly of carnallite and smaller quantities of sylvinite.

Currently the Ethiopian Government has plans to exploit the potash deposits with a production rate of 1.5 million tons per year starting in the late 1980s.

Fertilizer manufacture

There is no fertilizer manufacturing industry in Ethiopia. Its proximity to the Middle East phosphate producers from whom it could import raw phosphate and its potash and sulphur reserves and a reasonably high level of fertilizer consumption (46,000 tons of total NPK in 1981/82) could form a basis for a fertilizer industry.

GABON

Gabon has phosphate rock resources and also oil and gas (Table).

Phosphate rock has been located between St Catherine and Pointe Iguegue where it is associated with calcareous sandstone, between Fernan Vaz and Iguela and also at a location 150 km south-east of Port Gentil and 50 km south-east of d'Ombone. No reserve estimates have been given. (West Africa Fertilizer Study, PP. 55).

Some potassium salts have been identified in Lake Azingo but have not been evaluated.

Fertilizer Manufacture

Fertilizer consumption in Gabon is low (1,500 tons of total fertilizers in 1981/82) and this has not stimulated fertilizer manufacture inspite of the availability of gas and phosphate resources.

A plant to manufacture about 4,000 tons a year of sulphuric acid was established in 1967.

GAMBIA

Gambia has no petroleum, gas, hydroelectric power, phosphate or potash resources. Exploration effort for oil including in off-shore areas has not proved having any reserves.

The country imported a total of 5,700 tons of N P_2O_5 and K fertilizers.

GHANA

Ghana has some petroleum reserves and considerable hydroelectric power output (Table 1). No reserves of phosphate or potassium have been discovered in the country. However, it is felt that geological investigations should be pursued in the Voltaian sedimentary basin in view of several positive occurrences and sizeable phosphate deposits already discovered and in the process of being developed in the same geological formation in Burkina Faso (Anlit and Aloub Djouana), in Benin (Mekrou) and Niger (Tapoa).

Ghana imported a total of 46,800 tons of N P_2O_5 and K in 1981/82 of which 22,800 were N fertilizers.

Plans have been made in the past to have an NPK compounding plant in Ghana based on imported ammonia, phosphate rock and potash, but no fertilizer project has been implemented.

GUINEA

Guinea has no phosphate or potash resources. The country has substantial hydroelectric power potential. Exploration for oil is in progress. Fertilizer consumption is low, total imports of NPK fertilizers in 1981/82 having totalled 2,800 tons only. Lack of natural resources and low market demand is not likely to encourage early development of a fertilizer industry in the country.

GUINEA-BISSAU

A calcium phosphate find meriting further exploration has been reported in northern Guinea-Bissau.

IVORY COAST

Ivory Coast has some petroleum production and a limited hydroelectric potential.

The country does not have phosphate or potash resources.

A fertilizer industry has been built up utilizing feedstocks including phosphate from Togo. In 1981/82 a total of 4,700 tons of N and P_2O_5 fertilizers was produced in the country.

KENYA

The country does not have known potash, coal, oil or gas resources. It has a modest hydroelectric power potential while electricity generated from geothermal plants in the Rift Valley accounts for 10 per cent of the country's electricity consumption in 1983.

Kenya's fertilizer consumption is relatively high but has little installed fertilizer manufacturing capacity. The country imported 79,700 tons of NPK fertilizers in 1981/82.

There is a small 4,000 tons/year sodium phosphate plant at Turbo using Sukulu phosphate rock from Uganda, and alkali salts from Magadi Lake Sida.

There have been plans to build a 110,000 tons/year fertilizer plant at Mombasa to produce 27 per cent N calcium ammonium nitrate (Directory of Food Production).

LIBERIA

Liberia has no proven petroleum or gas reserves. The country also does not have phosphate rock or potash reserves. However, iron phosphate minerals of no economic significance were discovered in high grade iron ore at Bomi Hill and Bambuta in Western Liberia.

Fertilizer consumption is only about 3,400 tons of N P_2O_5 and K. Prospects for the estalbishment of a local fertilizer industry are therefore limited.

LIBYAN ARAB JAMAHIRIYA

Libya has large resources of petroleum and natural gas (Table 1). It also produces as a by-product, sulphur from the petroleum and gas refining industries. The country also has relatively large deposits of potassium salts but has no phosphate deposits.

Apart from a production of about 150,000 tons a year of contained nitrogen in ammonia, Libya imports most of its fertilizer requirements.

Potash deposits

There are three different potash deposits in Libya - at Marada, Busida and at Idry.

Marada

The potassium salt deposits are found in tertiary salt sebket (salt pans) covering an area of 150 sq km. In 1939 the carnallite deposit was partially explored by an Italian company and assessed to contain 1.5 million tons of potassium salts and 7.5 million tons of magnesium chloride. Some mining of the deposit was done and the material was exported to Italy.

An extensive drilling programme was carried out on the deposit in 1962 and the following reserves were established over an area of 27 sq km.

- 18 sq km of brine area (1.13 per cent K_2O content) with 955,600 tons of refined potassium sulphate (2.28 - 5.16 per cent mg content) with 1.2 million tons of refined magnesium product;

- 9 sq km salt area containing 4,708,600 tons of refined potassium sulphate and 868,300 tons of magnesium.

Busida deposit is located 150 km west of Tripoli. It covers an area of about 50 sq km and contains predominantly Halite salts near the surface and possible economic quantities of magnesium and potash salts in depth.

Idry deposit is located 150 km west of Brak in Fezzan. It has sodium chloride as the predominant salt and some magnesium chloride. Considerable amount of potassium salts may be present north of the main salt deposit under a sand dune and further exploration work is required to substantiate these indications. Transportation difficulties have impeded exploitation of the Idry deposit.

At Bezema, in a small oasis about 100 km north west of Kupra, marshy salty lake formed from the inflow of water from a hot salt water spring and covering an area of about 1 sq km contains salts with potassium content of 3 to 6.7 per cent and sulphate (SO_4) content of 2.7 to 10.9 per cent.

MADAGASCAR

The country has potential for oil, gas, tar, sand and coal which are being investigated. There is also some hydroelectric power potential in the country. On Juan de Nova island a deposit consisting of collophanite concretions and powder averaging 29.1 per cent P_2O_5 has been found (de Kun, PP. 574).

There is a petroleum refinery located at Tamatave.

Fertilizer manufacture

A fertilizer plant has recently been built at Tamatave to produce 90,000 tons of urea per year using imported feedstock.

MALAWI

Phosphate deposits with reserves estimated at 800,000 tons/year of apatite with over 20 per cent P_2O_5, and 1.5 million tons with less P_2O_5 have been located in carbonatites in the Shire valley. Iron pyrites with an average sulphur content of about 10 per cent have also been found in the Kangankunde carbonatite. Reserves are estimated at 2.3 million tons.

Conditions favourable for oil and gas formation have been reported below Lake Malawi.

Malawi has no fertilizer industry but an economic appraisal for establishing a fertilizer plant based on pyrites and phosphate was done in 1967. The country imported 24,600 tons of NPK fertilizers in 1981/1982.

MALI

Mali has phosphate rock reserves estimated at 25 million tons of phosphate rock with over 28 per cent P_2O_5 in the Tilemsi Valley north of Gao. A phosphate rock crusting plant has been installed to produce some fertilizer for local consumption. The deposit is currently the focal point of an experimental programme carried out jointly with the International Fertilizer Development Centre aiming at producing low-cost phosphate fertilizer implying limited capital investment.

About 30,000 tons of phosphate is being mined per year and there are plans to raise this production to 240,000 tons per year (Mineral Yearbook, 1981).

The country imported a total of 13,100 tons of NPK fertilizers in 1981/1982.

MAURITANIA

Mauritania has a phosphate rock deposit near its southern border with reserves estimated at between 20 and 40 million tons of ore. Plans to open a mine of a capacity of 500,000 tons per year have been under consideration.

The country's consumption of fertilizers is negligible.

No petroleum or gas reserves have been discovered but exploration for oil is in progress.

MAURITIUS

Phosphate deposits of guano type are found in some of the Mauritius islands.

Fertilizer manufacture

The Mauritius Chemical and Fertilizer Industry Ltd is operating a 100,000 tons/year capacity fertilizer plant capable of producing different NPK formulations including about 10,000 tons/year of calcium ammonium nitrate.

The plant is based on imported anhydrous ammonia, phosphoric acid and potash. Some of its output is exported (Table 8).

MOROCCO

Morocco has the largest reserves of phosphate rock in the world. It also has some limited reserves of petroleum, natural gas, coal and potassium salts. The country also has pyrite deposit and pyrrhotite deposits.

Phosphate

Morocco is the world's largest exporter and third largest producer of phosphate rock. The country accounts for over 30 per cent of the world exports and 14 per cent of the total world phosphate production.

Current annual production is over 18 million tons most of which is exported to Western European countries whose proximity gives Morocco competitive market advantage especially in regard to freight costs. Exports in 1981 were 15.6 million tons while domestic sales were 3.5 million tons or 18 per cent of the production which was considerably higher than the consumption of 3 per cent in 1970.

The country has reserves of over 64 billion tons of phosphate rock with over 21 per cent P_2O_5 and about 28 billion tons of rock with 9 to 21 per cent P_2O_5.

The main reserves are located on the Oulad Abdoun plateau with Khouribga as the mining centre and on the Ganntour plateau where mining is centred at Youssoufia and in the Meskala area where no mining has as yet been done.

Apart from the production of phosphate rock there is a limited production of fertilizers mainly based on phosphate rock.

Office Cherifien des Phosphates (OCP) operates a complex built in 1966 near the port of Safi. This complex includes a sulphuric acid plant with an annual rated capacity of 429,000 tons to a phosphoric acid plant with a capacity of 300,000 tons per year, a triple superphosphate plant with a capacity of 400,000 tons/year and an ammonium phosphate plant with a capacity of 300,000 tons per year. Sulphuric acid production is based on the roasting of pyrite ore obtained from a pyrite deposit located at Kettara containing 31 to 33 per cent sulphur.

Another plant at Ain Sebaa built in 1923 has rated annual capacities of 150,000 tons of single superphosphate (16 per cent P_2O_5) and 55,000 tons of sulphuric acid. There are also phosphate rock calcining plants at Safi, Kenitra and Berrechid with a total capacity of 100,000 tons per year of product (28 per cent P_2O_5) (Africa Fertilizer). There are also a number of fertilizer blending plants in the country.

Morocco has already started to execute a long-term programme to build more chemical plants to produce and sell finished phosphoric products following rapidly rising costs of transporting large tonnages of low value phosphate rock and increasing environmental restrictions in several countries.

The Office Cherifien des Phosphates (OCP) plans to build plants around Jorf Lasfar and Nador to produce an additional 6,000 tons per day of P_2O_5 for production of phosphoric acid.

Expansion programme at Safi have been done to increase phosphoric acid production from a daily feed of 4,500 tons of P_2O_5. Eight phosphoric acid

units of 500 tons per day P_2O_5 are also being set up at Jorf Lasfar in Morocco Phosphore III project. The schedule is to bring the plants on stream over a three-year period starting 1983.

There are also plans by OCP to build units for the production of superphosphoric acid and diammonium phosphate.

A new port has been built at Jorf Lasfar to facilitate exports of phosphate fertilizers.

Potash

Deposits of carnallite have been discovered at Khemisset while deposits of sylvinite have been discovered west of Khemisset. The deposit of sylvinite are estimated at 50 million tons of ore with an average content of 11 per cent K_2O. Consideration has been made to exploit this deposit but there is no production of potassium ores at present.

Nitrogenous fertilizer

Morocco has started production of nitrogen fertilizers. In 1981/82 the country produced about 12,000 tons of N equivalent.

Pyrite and pyrrhotite

Morocco has a cupriferous pyrrhotite mine at Kettara. Other pyrrhotite occurrences have been located at Ben Sliman, Kerkoz, Bouhane, Lachach Drna Selgout, Ait Said, Boukeris, Jebel Ahmar, Kouliat Aicha, Sidi-Embarek and Tazakourt. Reserves range between 100,000 to 1 million tonnes. (World Survey of Sulphur Resources Ltd., PP. 138).

Production which is about 4,000 tons per day meets the needs of sulphuric acid and the fertilizer industry in the country.

MOZAMBIQUE

The country has considerable coal reserves and a big hydroelectric power capacity at the Cabora Basa Dam (Table 1).

Annual coal production is about 300,000 tons a year and there are plans to increase it to 5 million tons a year, mainly for export.

Prospecting for petroleum and gas is continuing. Gasfields have been discovered in the Pande, Buzi and Temane areas with the recoverable reserves at Pande estimated at 18 billion m^3 and possible recoverable reserves of 60 billion m^3.

Occurrences of apatite in association with the carbonatite core of the alkaline volcanic intrusion of Muambe (Tete region) is reported without any information regarding the economic value of the deposits.

Some minor guano occurrences with a phosphate P_2O_5 content of 8.5 to 10.6 per cent has been found near Vilanculos and Sane River.

Pyrrhotite is found near the Zimbabwe Border about 45 km south of Manica.

Fertilizer manufacture

A plant for the production of 50,000 tons/year of sulphuric acid, 60,000 tons/year of ammonium sulphate and about 10,000 tons/year of single superphosphate equivalent to 12,000 tons/year of N and 2,000 tons/year of P_2O_5 started production in 1968 at Natola.

A 1,000 tons/day ammonia plant has been considered at one time to utilize the Pande natural gas.

NIGER

Niger has no gas resources and has so far not discovered any petroleum in economic quantities although traces of oil are reported at Tiu Touma. The country is one of the three African developing nations producing and exporting uranium; it also has about 6 million tons of coal reserves at Anolis Araren about 50 km east of Agadés. Phosphate rock deposits have also been discovered in the country but there is no fertilizer production in the country.

Fertilizer imports are not substantial. In 1981/82 only 1,700 tons of N and 1,700 tons of P_2O_5 fertilizers were imported and consumed.

Phosphate rock

A phosphate deposit has been discovered near Tapoa. A feasibility study for phosphate production has been done. Resources of 1.25 billion tons of phosphate have been identified out of which 500 million tons are considered economically exploitable.

The ore is in three horizons. The uppermost zone has an average of 22.4 per cent P_2O_5 while the two lower horizons have grades between 27.8 per cent and 34 per cent P_2O_5.

Some hand-picked production of phosphate rock is currently being made near Takova where a 15 ton-per-day crushing plant has been installed.

NIGERIA

The country has large reserves of petroleum and natural gas but has neither reserves of phosphate of commercial significance or potash. It has important coal reserves (Table 1).

However, minor occurrences of sedimentary phosphate rocks are reported in Paleocene - Lower Eocene known as Oshosun Formation and Akombo Formation in Abeokuta Provinces.

Nigeria has increased appreciably its fertilizer consumption having increased from a total of 13,100 tons in 1970/1971 to a total of 213,200 tons of NPK fertilizers in 1981/1982. About 97,000 tons were N fertilizers.

Based on the large local demand for fertilizers and the national gas reserves the country has a sound base for the establishment of a fertilizer industry especially N fertilizers for local consumption and for export.

Fertilizer industry developments have so far included the establishment of 50,000 tons/year single superphosphate plant near Kano or Nadune based on phosphate rock from Togo and the production of 50,000 tons/year of calcium ammonium nitrate based on ammonia plant (using natural gas, nitric acid and local limestone.

RWANDA

Rwanda has considerable natural gas reserves in Lake Kivu estimated at 57 billion m^3. The country has also reserves of peat of the order of 550 million m^3 (wet) with high ash content (15 to 25%). In addition, the country has an adequate hydroelectric power potential to meet domestic and industrial needs.

An agreement was reached with Burundi and Zaire in 1981 to evaluate the viability of exploiting the gas resources as well as the development of a 140 megawatt hydroelectric dam on the Ruzizi river. However, the hydropower scheme now under construction will only have a 40 megawatt capacity.

The development of a fertilizer industry could be envisaged with the availability of cheap power.

REUNION

Réunion has considerable fertilizer consumption largely for the sugar industry (Table 8) 36,000 tons of NPK fertilizers were consumed in 1981/1982.

The island has no resources for a fertilizer industry.

SENEGAL

Senegal has large reserves of calcium phosphate and aluminium phosphate. The country also has peat and some petroleum reserves. A petroleum refinery located at Mbou has had its capacity increased to about 1.38 million tons a year.

Senegal's total fertilizer consumption was 24,300 tons in 1981/82 while its exports of N P_2O_5 fertilizers was 15,100 tons.

Calcium phosphate rock deposits

There are several deposits of calcium phosphate rock over a plateau north-east of Dakar.

A calcium phosphate deposit at Taiba, some 110 km from Dakar covers about 10 square miles and has reserves of over 110 million tons of an average grade of 57 per cent tricalcium phosphate. Recoverable reserves have been estimated at between 30 to 40 million tons of 82 per cent rock, (37.3 per cent P_2O_5 and 52 to 54 per cent CaO). There are also reserves of about 100 million tons of run of the mine ore below 30 m depth.

The ore is mined by open-cast and is then up-graded by flotation. Production of up-graded ore is over 1.2 million tons per annum. The ore is exported mainly to the United Kingdom, France, Greece and India. Other phosphate deposits are found at:

- Lam-Lam near Thies where reserves of about 3.5 million tons of hard rock phosphate containing 18 per cent P_2O_5 and 10 per cent Fe_2O_3 have been identified. Exploitation of this deposit has been limited by ore's high iron content. Limited amounts of the phosphate are mined and ground and used locally as a fertilizer.

- Sebikatane and Pointe Sarene with rock averaging 20 to 25 per cent P_2O_5 and 12 to 15 per cent P_2O_5 respectively but have high iron contents which has discouraged their exploitation.

- Cive: Close to the Mauritania border has reserves of about 1 million tons of phosphate rock which were exploited for some time but abandoned.

Aluminium phosphate deposit

An aluminium phosphate deposit at Pallo near Thies contains about 28.5 per cent P_2O_5 to 32 per cent Al_2O_3, 5 to 10 per cent Fe_2O_3, 8 to 11 per cent CaO, silica and TiO_2. Proven and possible reserves which include less rich ore total over 100 million tons.

The deposit has a thickness of 20 to 30 feet, is near the surface and is therefore mined by open cast methods. The complexity of the ore has imposed some limitations in the processing for fertilizer products.

Some of the ore is calcined to increase the P_2O_5 content to 35 per cent.

Peat

Senegal has peat resources estimated at about 50 million cubic metres largely in the central region of Niayes.

Sulphuric acid and fertilizer manufacture

The country has started a project to construct a 2,100 ton-per-day sulphuric acid plant and an 800-ton-per-day phosphoric acid plant at Taiba. A mixed fertilizer plant to produce 580 tons per day of diammonium phosphate and 900 tons per day of granulated triple superphosphate is to be built at Mboo.

SIERRA LEONE

Sierra Leone has not yet discovered petroleum resources but exploration work is in progress. A small deposit of coal has been discovered in the country but may be uneconomical to exploit.

The country has no phosphate or potash reserves.

Total fertilizer consumption in the country is small. Consumption in 1981/1982 was only 3,300 tons of NPK fertilizers which was all imported.

SOMALIA

Somalia has no proven coal, oil, phosphate or potash deposits. Its fertilizer consumption is also low. Only 1,300 tons of NPK fertilizers were used in 1981/1982.

SOUTH AFRICA

South Africa has very large coal reserves estimated at some 100 billion tons (Table 1) and annual production, having produced about 130 million tons in 1981. The country has phosphate resources but has no potash. Search for oil and gas is continuing and some gas has been discovered offshore. There are several pyrite deposits in the country.

Phosphate rock

Most of the country's phosphate rock production comes from the Palabora copper-bearing carbonatite deposit in the Transvaal province. Apatite containing 8 to 9 per cent P_2O_5 is found in the deposit. The material is mined and up-graded to over 30 per cent P_2O_5. In 1981 17.7 million tons of ore were mined and a phosphate concentrate of 2.6 million tons was produced against 3.0 million tons in 1980.

Pyrites

The country has pyrite production from several localities. About 1.45 million tons of pyrites were mined in 1981 producing about 500,000 tons of sulphur. By-product sulphur from metallurgical processes and from the petroleum industry was about 125,000 tons in 1981.

Fertilizer manufacture

South Africa has several fertilizer manufacturing plants in a number of locations.

The country has a large facility for producing petroleum from coal and a number of petrochemical intermediates. Several fertilizer manufacturing plants are associated with this operation.

These plants include a synthetic ammonia facility, an ammonium sulphate plant, a nitric acid plant and calcium ammonium nitrate plants.

Urea, phosphoric acid, sulphuric acid NPK and other fertilizers are produced by several manufacturers in the country. South Africa in 1981 manufactured about 825,000 tons of phosphatic fertilizers and nearly 1.9 million tons of artificially mixed fertilizer blends which included some phosphate. It also exported about 230,000 tons of phosphoric acid.

SUDAN

Sudan's economy is based on agriculture and the country has shown considerable increase in the consumption of nitrogenous fertilizers in the last ten years (Table 6).

Petroleum has been discovered in the country since 1979. The country also has considerable natural gas reserves but has no phosphate or potash resources (Table 1).

Pyrite is found as a major constituent in copper sulphide ores in the Hofrat el Nahas mines but has not been recovered as a by-product.

As the country imports considerable amounts of nitrogenous fertilizers, it can be expected that the country will look into the viability of utilizing the natural gas resources in the manufacture of ammonia and urea.

SWAZILAND

The country does not have phosphate or potash resources. It however has considerable coal reserves (Table 1).

Fertilizer consumption in the country has shown considerable increase from 6,100 tons in 1971/1972 to 19,300 tons of NPK fertilizers in 1981/82.

There is no fertilizer manufacture in the country.

TOGO

Togo has considerable phosphate rock resources but has no potash. Also oil and gas have not been discovered in the country.

Phosphate deposits in the country form a belt extending 18 miles north-east starting with Adeta deposit located north-east of Lomé. Other deposits in the belt are Kpome, Hahotoe, Dagbati and Momé.

The phosphate rock contains 25 to 40 per cent clay and some traces of uranium. Total reserves are estimated at over 130 million tons of rock containing over 21 per cent P_2O_5.

Mining of the Kpome deposits began in 1961. A concentration plant employing hydraulic cyclones and centrifugal separators to remove clay is located at Kpome.

About 2.9 million tons of phosphate rock with a P_2O_5 content of about 1 million tons were produced in 1980. Production capacity is about 3.4 million tons a year but the country has had to produce below capacity in view of weak fertilizer markets.

Fertilizer manufacture

Plans have been under way for the construction of a 1,000 tons per day phosphoric acid plant.

TUNISIA

Tunisia is a producer and net exporter of phosphate fertilizers. The country also has reserves of petroleum and natural gas (Table 1) although it does not produce nitrogenous fertilizers at the moment. Some potash resources have also been identified in the country.

Phosphate

Tunisia has nearly 8 billion tons of phosphate rock averaging over 21 per cent P_2O_5 and 1 billion averaging below 21 per cent P_2O_5. The main phosphate deposits are located in the central region of the country around Gafsa, Kalaa Djerde and Metlaoui.

Production since 1979 has exceeded 4 million tons of phosphate rock a year and there are plans to expand this production to about 10 million tons by 1990.

Most of the country's production is from the Gafsa basin where Cie des Phosphates de Gafsa (CPG) operates six underground mines and one open cast mine. CPG also has an underground mine at Kalaa Knasba.

Expansion plans include development of four new open-cast mines in the Gafsa Basin and other mine at Sra Quertane in the north-west of the country.

A direct rail line has been built between Gafsa and Gabes where fertilizer plants are located.

Because of the relatively low grade of the Gafsa phosphate rock, Tunisia has for sometime converted some of its ore to phosphoric acid for export. A plant at Gabes operated by SAEPA produced 400,000 tons of phosphoric acid in 1981 most of which was exported. There are also phosphoric acid, sulphuric acid and triple sulphate manufacturing plants at Sfax and near Tunis with total annual capacities of 350,000 tons H_2SO_4, 100,000 tons of phosphoric acid, 150,000 tons of calcined rock, 10,000 tons of single phosphate and 350,000 tons of triple superphosphate.

On the whole Tunisia consumes nearly two thirds of its total phosphate production, but the expansion programmes should enable the country to increase its exports considerably while maintaining local supplies.

Tunisia has been exporting its phosphate rock and phosphoric acid products to Europe, the Middle East, Latin America and more recently to China.

Potash resources

Three areas have been identified in Tunisia as containing potash salts: (a) Chott El Djeria west of Gabes, El-melah near Zarzis and Mallahat el Barigah on the Tunisia-Libya border.

There are plans by a government comapny to start a small operation to produce potassium sulphate from the Chott El Djeria deposit.

Pyrite

Pyrite occurrences are found in cretaceous rocks at Ain Grich near Bejaoua and at Djebel Kebbouch near Sakhiet Sidi Youssef. (World Survey of Sulphur Resources, PP. 142).

UGANDA

The country has no known oil or gas reserves but has hydroelectric power from the Owen Falls on the river Nile.

Apatite in carbonatite bodies is the only commercial and potential source of phosphate in Uganda. Such deposits are found at Bukusa, Sukulu, Sekululo, Budeda and Tororo in eastern Uganda in carbonatites of cretaeeons age whereas carbonatites of Tertiary age are known at Calala Hill, Moroto, Filgan, Kadam and Tororo.

Reserves at Bukusa are estimated at 50 million tons. The deposit was mined up to 1962 and the ore exported to Kenya. The Sukulu deposit has ore reserves of about 200 million tons containing 12 to 15 per cent P_2O_5 and magnetite and pyrochlore.

Mining of the deposit has been by open cast and the ore is processed to give 16,000 tons a year of concentrate containing 40 per cent P_2O_5. The concentrate is used in the production of single superphosphate.

Pyrites are found in association with upper ores in the Kitembe copper mine. Pyrite constitutes up to 12 per cent of the ore and has cobalt. Stock piles of the pyrite have been kept with a view to recovering cobalt and possibly manufacturing sulphuric acid.

Potassium chloride

The salts in Lake Katwe contain some potassium chloride.

Fertilizer manufacture

A fertilizer plant at Tororo has a capacity to produce 25,000 tons a year of single superphosphate. The plant uses phosphate rock from the Sukulu mines while the required sulphur is imported for the manufacture of sulphuric acid.

A study has recently been commissioned to determine ways of rehabilitating the fertilizer industry in the country which has declined considerably in the last ten years. Possibilities of establishing a new phosphate plant and a sulphuric acid plant using pyrites from Kilembe deposits are being considered.

UNITED REPUBLIC OF TANZANIA

The country has some coal and natural gas resources and the search for oil is continuing. There is also hydroelectric power potential.

Phosphate rock is found at Minjingu in the Hanang district some 100 km west of Arusha. The deposit has about 20 million tons of hard and soft phosphate rock.

A mine with a capacity of 100,000 tons a year was opened in 1982. The mine's ore is up-graded to about 30 per cent P_2O_5 in a plant at the mine site before it is transported by trucks to Arusha and then by rail to a fertilizer plant in Tanga.

Apatite deposits have been located at Zizi in the Morogoro district and in a carbonatite deposit at Pande Hill near Mbeya. Feasibility studies aimed at developing these deposits are being undertaken.

Potassium salts are found in saline spring waters and salt lakes of the Western Rift valley system. For example, salt produced at Ivuna in Mbeya region has 5 per cent potassium chloride.

The Urinza salt, east of Lake Tanganyika, also has potassium and magnesium chloride salts in it.

Sulphur pyrites. Sulphur is found in Kibo Crater of Mount Kilimanjaro but is not likely to attract commercial exploitation. At Samena in the Geita district, a pyrite deposit which could warrant exploitation for the manufacture of sulphuric acid is found.

Fertilizer manufacture

A fertilizer plant located at Tangar has rated annual capacities of 20,000 tons of ammonium sulphate, 15,000 tons of diammonium sulphate, 25,000 tons of triple superphosphate and 45,000 tons of NPK compound fertilizers with corresponding production facilities for sulphuric and phosphoric acids.

Feedstock comprising of calcium chloride (14,000 tons/year) and phosphate rock (100,000 tons/year) has been imported. Beginning 1983 the plant started to receive some of its phosphate rock requirements from the newly opened Minjingu mine.

Sulphuric acid could also be produced using the Samena pyrites if these are exploited.

Plans are under way for the construction of a 300,000 ton per year urea plant utilizing the Songo Songo gas reserves. A good proportion of the production would be exported.

WESTERN SAHARA

Rich phosphate deposits were discovered in Western Sahara in 1963. Reserves of over 25 billion tons of phosphate rock grading over 21 per cent P_2O_5 and about 8 billion tons grading between 9 and 21 per cent P_2O_5 have been identified.

At the Bu Craa deposit which has proven reserves of over 1.6 billion tons production reached a peak of 2,681,000 metric tons in 1975 but has since declined.

ZAIRE

Zaire has oil and gas reserves as well as coal (Table 1). The country also has indications in the Lower Zaire Basin of phosphate rock, potash and pyrites but these have not been evaluated.

Most interesting from a commercial point of view is the apatite associated with pyrochlore in the carbonatite complexes at Bingu and Lueshe (North Kivu lake area which are under consideration for development and recovery of its pyrochlore content).

The copper deposits found in Shaba have sulphide ores whose gases upon roasting can be used to produce sulphuric acid.

Fertilizer manufacture

A number of plans for the establishment of a fertilizer industry in Zaire have been made in the past although development work has not been accomplished.

One of the plans aimed at producing 90,750 tons/year ammonium calcium nitrate based on fuel oil and exporting some of the production to Cameroon, Congo, The Central African Republic and Gabon.

The country has a production capacity of 175,000 tons a year of sulphuric acid based on sulphur contained in copper and zinc concentrates smelted at Likasi. The zinc concentrates from the Kipushi mine are reported to have a sulphur content of 25 per cent (World Survey of Sulphur Resources Ltd., PP. 142).

ZAMBIA

Zambia has some coal reserves at Mamba and considerable hydroelectric power from the Kariba Dam and the Victoria Falls (Table 1). The country does not have potash resources but has recently discovered phosphates in the form of apatite in intrusive limestones.

Phosphate rock

Large high grade phosphate deposits have recently been discovered at Kaluwe and at Pentanke in Eastern Province. Reserves are estimated at 200 million tons and their early exploitation is planned.

Fertilizer manufacture

A plant at Kafue has a capacity to produce about 26,000 tons of nitrogen a year as ammonium nitrate. There are also facilities for the production of ammonia from local coal and nitric acid taking advantage of the available hydroelectric power. Phosphates used in the plant are imported.

Sulphuric acid

A sulphur industry has been developed in Zambia based on the copper in the copper belt and zinc sulphides. Also at Broken Hill sulphuric acid is manufactured from mixed sulphides. Total sulphuric acid capacity in the country is in excess of 300,000 tons per year.

ZIMBABWE

Zimbabwe has large coal reserves at Wankie, very high hydroelectric power potential at Kariba and some phosphate and pyrite reserves.

Phosphates

Three carbonatites complexes securing in the valley of the Sali River, in Bastiru Zimbabwe, have been identified as potential sources of phosphate: Dorowa, Shawa and Chishanya.

The Dorowa deposit with reserves of about 16 million tons (14 per cent BPL) is supplying with phosphate the fertilizer plant near Harare. The phosphate rock is mined and processed to up-grade it to about 76 per cent BPL at a rate of about 120,000 tons a year. The Shawa and Chishanya carbonatite complexes are either uneconomic due to low P_2O_5 content and/or on account of complex processing techniques to be applied to the primary ore.

Pyrites

A pyrite deposit with reserves of 2 million tons of 38 per cent content is located 30 km north of Harare. About 60,000 tons of pyrite is mined a year.

Fertilizer manufacture

There are two sulphuric acid plants based on local pyrites with total capacity of about 120,000 tons a year and a phosphoric acid plant with a capacity of about 20,000 tons a year of P_2O_5.

The country also has a single superphosphate (19 per cent P_2O_5) plant with an annual capacity of about 70,000 tons a year and a triple superphosphate (44 per cent P_2O_5) plant also with an annual capacity of 70,000 tons a year There are also fertilizer blending plants in the country.

An ammonia synthesis plant with a capacity of 52,000 tons a year was installed in 1982. Hydrogen used in the plant is obtained by electrolysis of water.